In Situ Polymerization via Environmentally-Borne Initiation Stimuli

Completed Technology Project (2015 - 2019)

Project Introduction

The goal of my research is to develop novel polymeric materials that solidify upon exposure to an environmentally-borne initiation stimulus. Specifically, I propose the investigation of novel, in situ polymerizable materials based upon the radical-mediated thiol-ene reaction mechanism. This reaction mechanism has been a focus of recent attention as a click reaction, particularly for polymerizations, owing to its desirable combination of characteristics, including high yield, reaction specificity, and modularity. As thiol-ene reactions are extraordinarily resistant to oxygen inhibition, oxygen will be employed as a ubiquitous, environmentally-borne reactant. This mechanism will enable the development of materials that improve upon existing technologies used in the human habitation of space. The described research project will focus both on the fundamental chemistry and evolution of the polymer networks, and on the utilization of the polymerization initiation approach to yield materials that address the requirements of specific applications. Redox reaction mechanisms that utilize atmospheric oxygen to generate radicals will be investigated for the in situ polymerization of thiol-ene-based materials and the physicochemical properties of the resultant polymer networks will be characterized. To demonstrate the versatility of this approach, its utilization in two space technology applications will be investigated. Initially, surgical adhesives will be developed for use as emergency hemostats and other medical procedures that may be necessary to perform during space travel. Subsequently, a self-healing material that is able to flow and polymerize immediately after being punctured, thus sealing a wall defect, will be designed as a unique and robust atmosphere-loss prevention mechanism; such a material could be sandwiched within the layers of space suits or the walls of a spacecraft.

Anticipated Benefits

Subsequently, a self-healing material that is able to flow and polymerize immediately after being punctured, thus sealing a wall defect, will be designed as a unique and robust atmosphere-loss prevention mechanism; such a material could be sandwiched within the layers of space suits or the walls of a spacecraft.

Project Image In Situ Polymerization Via Environmentally-borne Initiation Stimuli

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Organizational Responsibility

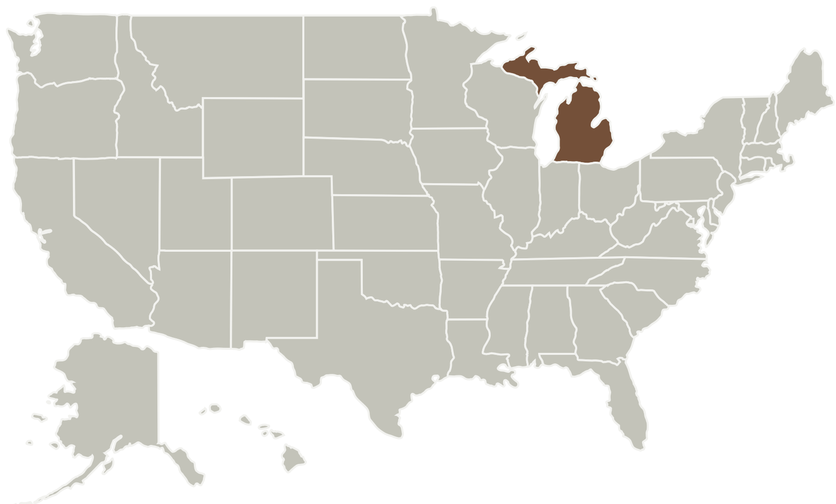
Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Responsible Program:

Space Technology Research Grants

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
University of Michigan-Ann Arbor	Supporting Organization	Academia	Ann Arbor, Michigan

Primary U.S. Work Locations
Michigan

Project Management

Program Director:

Claudia M Meyer

Program Manager:

Hung D Nguyen

Principal Investigator:

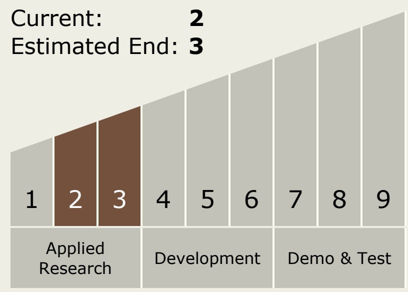
Timothy Scott

Co-Investigator:

Scott R Zavada

Technology Maturity (TRL)

Start: **2**
Current: **2**
Estimated End: **3**



Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  └ TX12.1 Materials
    └ TX12.1.1 Lightweight Structural Materials

Images

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Project Image In Situ Polymerization Via Environmentally-borne Initiation Stimuli
(https://techport.nasa.gov/image/1781)

Project Website:

https://www.nasa.gov/directorates/spacetech/home/index.html